

## FORCE SENSITIVE TOUCH PANEL

This is a continuation of copending application of Ser. No. 07/484,123 filed on Feb. 22, 1990 now abandoned.

### TECHNICAL FIELD

This invention relates to data input devices and more particularly to touch panels, touch pads, touch screens and the like which generate different signals when different specific areas of a panel are touched.

### BACKGROUND OF THE INVENTION

Electromechanical keyboards, keypads or banks of switches or the like have traditionally been used to enable an operator to input control signals and other data to apparatus of various kinds. Such devices are mechanically complicated, bulky, easily damaged and wear rapidly. The more recently introduced touch panels or touch screens tend to be less subject to these problems and are rapidly replacing the electromechanical forms of data entry device.

Touch panels have a panel member, means for sensing touching of the panel by a human finger or a hand held tool of any of various kinds and means for generating electrical signals in response to touching of the panel. Touching of different specific areas of the panel produces different predetermined signals thereby enabling operator selection of desired control signals and operator transmission of desired data to the apparatus that is coupled to the touch panel. The different areas of the panel that are touched to input, different control signals or different alphanumeric characters can be marked on the panel and thus the operator may use the panel in much the same manner as one operates an electromechanical keyboard or keypad.

Touch panels can be used to input instructions or other data into diverse types of apparatus of varying degrees of complexity, computers, industrial process control systems, automatic teller machines at banks and home appliances being examples. In the case of computers and similar devices that are connected to a cathode ray tube, liquid crystal display or other visual data display, the touch panel may be transparent and be affixed to the screen of the display. Such touch panels, termed touch screens, enable the operator to select menu items or enter other data by simply touching the appropriate area of the display screen thereby eliminating the need for a separate keyboard or keypad.

Prior touch panels sense touching of the panel member and the specific location of the touch by any of several techniques. These include detection of a change of capacitance at the touched area, detecting interruption of infrared beams which scan along the panel, sensing changes in voltage drop across resistive screens or orthogonal grids that are brought into contact by pressure on the panel and detecting changes in an acoustic wave pattern caused by a finger or other object in the vicinity of the screen.

Ideally, a touch panel should have a simple and inexpensive construction, offer high resolution with respect to distinguishing between touches at closely spaced points, be durable and wear resistant and be insensitive to temperature fluctuation and humidity. In the case of touch screens, the panel should also be highly transparent. Each of the prior types of touch panel lacks at least some of these attributes and selection of a touch panel

for a particular usage has involved trade-offs between desirable properties.

In general, prior touch panels and screens are undeniably limited with respect to the amount of data that can be entered with a single touch. The information that is communicated by one touch of the panel is confined to the fact that an entry is being made and data indicative of the location at which the panel is being touched. Operations would be simplified if additional information could be communicated by the same touch.

The present invention is directed to overcoming one or more of the problems discussed above.

### SUMMARY OF THE INVENTION

In one aspect of the present invention, a touch sensitive panel for generating selected ones of any of a plurality of different signals, each of which is generated by touching a different location on the panel, includes a panel member and a plurality of panel member supports situated at spaced apart regions of the member. Force sensing means sense the magnitudes of the forces that are applied to each support by the panel member when the member is touched at a selected location. The apparatus further includes location analyzing means for sensing the location on the panel member that is being touched by comparing the magnitudes of the forces that are applied to the supports by the panel member and for generating the one of the signals that corresponds to the sensed location.

In another aspect of the invention, the location analyzing means produces signals which have a first signal component indicative of the location at which the panel member is touched and a second signal component indicative of the pressure which is being exerted against the panel member at that location.

In another aspect of the invention, the force sensing means includes strain gauges secured to the panel member in the vicinity of the supports.

In another aspect of the invention, the force sensing means include electrical resistors of the type which exhibit a change of resistance when pressure is exerted against the resistor, the resistors being disposed between the panel member and the panel member supports.

In still another aspect, the invention provides a touch panel for generating selected ones of a plurality of different signals wherein each of the signals is correlated with a different location on the touch panel and includes a panel member having a touch sensitive area bounded by first and second sides and first and second ends. A plurality of panel member supports support the panel member at spaced apart regions which are situated at the sides and ends of the touch sensitive area. The apparatus further includes a plurality of force sensing electrical circuit components of the type in which electrical resistance varies in response to forces sensed by the components, each such component being secured to the panel member in position to sense the force which the panel member exerts on an associated one of the supports. Means are provided for producing a plurality of electrical voltages each of which varies in response to changes of the resistance of a separate one of the force sensing components. Data processing means determine the location on the panel member against which pressure is exerted by comparing the forces which are sensed by the force sensing components and produce the one of the signals that correlates with that location.

In a further aspect of the invention, the data processing means includes a digital computer coupled to a